Additional Marine Benthic Algae from Howland and Baker Islands, Central Pacific[1]

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Abstract: Marine benthic algae from Howland Island and Baker Island were identified from collections made during earlier expeditions in 1924, 1935, and 1964, and during five separate expeditions between 1998 and 2004. Eighty-nine (six blue-green algae, 53 red algae, five brown algae, and 25 green algae) of the 99 species represent new records for the two islands. Forty-seven and 86 species are documented with voucher specimens from Howland Island and Baker Island, respectively. This study increases the total number of benthic marine algal species from the two islands to 104 species. A similar number (107 species) was previously reported from the nearby low coral islands in the Phoenix Group located 400 km to the southwest. Only 38% (39 of 104 species) of the algal species from Howland Island and Baker Island are reported from the Phoenix Group. The presence of *Udotea palmetta* Decaisne on Baker Island is of interest because the record is the first for this green algal genus in the central Pacific region.

Howland Island (0° 48′ N, 176° 38′ W) and Baker Island (0° 12′ N, 176° 29′ W) are two small isolated coral islands located adjacent to and just north of the equator in the central Pacific (Figure 1*A*) and are situated approximately 60 km apart. The islands consist of coral reefs and low sand islets, and are designated as no-take National Wildlife Refuges managed by the U.S. Fish and Wildlife Service. Both islands are similar in size but differ in shape (Figure 1*B*, *C*). Baker Island is oriented east to west, and Howland Island is oriented north to south. The closest island is Kanton (Canton) Island, the northernmost of the eight islands (Motteler 2006) in the Phoenix Group, Republic of Kiribati, located 400 km southwest of Howland Island and Baker Island.

The 20 species of marine benthic algae listed by Tsuda and Trono (1968) from Howland Island and Baker Island still remain as the primary records of the marine flora from these two coral islands. The 1968 study was based on specimens collected by Charles R. Long in July and October 1964 under the auspices of the Pacific Ocean Biological Survey Program, Division of Birds, Smithsonian Institution. The previously reported species included one species of Cyanophyta (blue-green algae or cyanobacteria), eight species of Rhodophyta (red algae), four species of Ochrophyta (brown algae), and seven species of Chlorophyta (green algae). Only one other species, *Herposiphonia dendroidea* Hollenberg,

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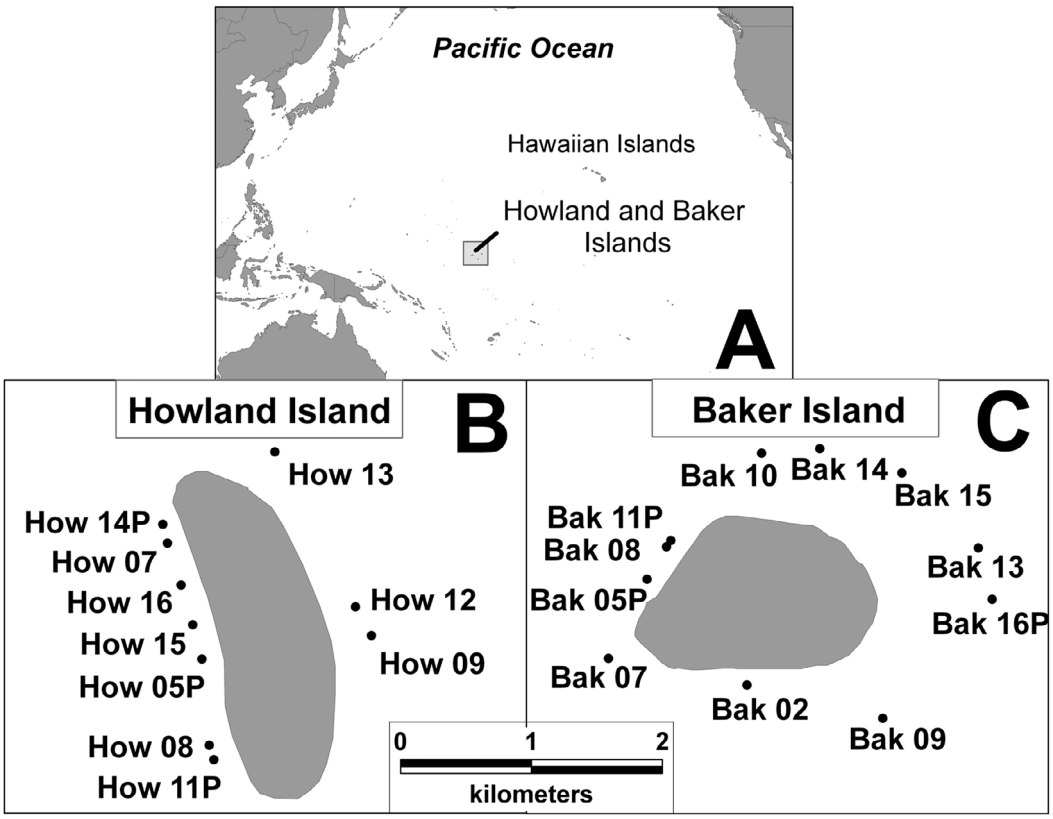

FIGURE 1. *A*, Location of Howland Island and Baker Island in the central Pacific. Howland and Baker Islands are located 400 km northeast of the Phoenix Islands in the Republic of Kiribati. *B*, IKONOS satellite image of Howland Island with NOAA's permanent algal transect and collection sites. *C*, IKONOS satellite image of Baker Island with NOAA's permanent algal transect and collection sites.

from Howland Island was reported by Hollenberg (1968*c*) during his study of Pacific *Herposiphonia*. Sixteen and 11 species were reported from Baker Island and Howland Island, respectively; only six specimens were recorded from both islands. Most specimens were relocated in the Herbarium Pacificum of the Bishop Museum.

Algal records are known from the eight coral islands of the nearby Phoenix Group. Schmidt (1928) reported the articulate coralline *Jania micrarthrodia* Lamouroux from McKean Island. Degener and Gillaspy (1955), Degener and Degener (1959), Dawson (1959*a*), and Taylor (1964) reported on the marine benthic algae of Kanton Island. Degener and Gillaspy (1955) reported 21 species identified by Maxwell S. Doty (11 reds, one brown, and nine greens). Degener and Degener (1959) included an annotated listing of blue-green algae (cyanobacteria) collected from terrestrial, freshwater, and a few marine habitats; the blue-green algae were identified and annotated by Francis Drouet.

Dawson (1959*a*) reported 51 species of marine algae (20 greens, nine browns, and 22 reds) from Kanton Island, which included three species of *Polysiphonia* and *Laurencia nana* Howe identified by George J. Hollenberg. In his study of the brown alga *Turbinaria*, Taylor (1964) reported *Turbinaria ornata* (Turner) J. Agardh from Kanton. Seven species of the family Rhodomelaceae were also reported from various islands in

the Phoenix Group: *Womersleyella pacifica* Hollenberg (Hollenberg 1967), four species of *Polysiphonia* (Hollenberg 1968*a*,*b*), and two species of *Herposiphonia* (Hollenberg 1968*c*).

Recently, South et al. (2001) reported 66 species of marine benthic algae from seven of the eight low coral islands in the Phoenix Group (seven species of blue-greens, 29 species of reds, five species of browns, and 25 species of greens), raising the total number of documented marine benthic algal species from the Phoenix Group to 107 species.

MATERIALS AND METHODS

The recent collections are primarily based on five separate expeditions (Appendix) to each of the two islands. The first collection was made by K.B.F. in March and April 1998 under the auspices of the U.S. Fish and Wildlife Service (USFWS). The second collection was made by Robin Newbold and Frank A. Parrish on a cruise of the NOAA Ship *Townsend Cromwell* in March 2000 (cruise TC-00-01) conducted by the Honolulu Laboratory, Southwest Fisheries Science Center, National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA). The third collection was made by Karen J. Geisler on a *Townsend Cromwell* cruise conducted by the Honolulu Laboratory's newly established Coral Reef Ecosystem Investigation (CREI) in February 2001 (TC-01-01). The fourth collection was made during another CREI cruise on the *Townsend Cromwell* during January and February 2002 (TC-02-01). A fifth collection was made on a cruise of the NOAA Ship *Oscar Elton Sette* conducted in January 2004 (OES-04-01) by the Coral Reef Ecosystem Division (CRED), Pacific Island Fisheries Science Center (PIFSC), NMFS, NOAA; CRED evolved from CREI when the Honolulu Laboratory became PIFSC in 2003. The latter two collections were made primarily by P.S.V., with a few specimens collected by Stephani R. Holzwarth and L. Scott Godwin. Collections on the second through fifth cruises are attributed here to NMFS.

Five specimens collected by Erling Christophersen during the September 1924 Whippoorwill Expedition, eight specimens collected by Albert F. Judd and Donald D. Mitchell during the June 1935 Itasca Expedition, and 10 unreported specimens collected in July or October 1964 by Charles R. Long during the Smithsonian Institution's Pacific Ocean Biological Survey Program from Howland Island and Baker Island (BISH specimen numbers) are also included here.

Specimens collected by K.B.F. are designated with his specific prefix (KN) and specimen numbers and, at times, with the prefix and specimen numbers of I.A.A. (IA). Some mounted specimens on glass slides possessed only numbers of IA and represent epiphytes and turf flora obtained from K.B.F.'s macroalgal specimens and from collections made by Robin Newbold and Frank A. Parrish. These collections were also assigned BISH numbers as recorded here, entered into a database, and deposited in the Herbarium Pacificum at the Bishop Museum. The NOAA Fisheries' PIFSC Coral Reef Ecosystem Division collections, which consist of herbarium specimens and mounted glass slides, are designated with collection numbers of P.S.V. (PSV) and are stored at PIFSC.

The higher-level classification system in Abbott (1999) and Abbott and Huisman (2004) was followed except for current changes. Annotations were included when specimens differed from the norm or were uncommon to the central Pacific, or to distinguish several species within a genus. The illustrated specimens represent species not commonly reported from the central Pacific. The voucher specimens associated with Baker Island and Howland Island and the references applicable to the algal species previously reported from nearby Phoenix Group are presented.

RESULTS

Division CYANOPHYTA
Order OSCILLATORIALES
Family OSCILLATORIACEAE

Lyngbya confervoides C. Agardh

Baker: BISH 725337 (IA 25114), Baker 1E; PSV 10361d, BAK-11A-01; PSV 10517, BAK-11P-04; PSV 10529, BAK-07-04; PSV

10541, BAK-05P-04; PSV 10573a, BAK-02-04. Howland: PSV 10230, HOW-15-02; PSV 10235, HOW-14P-02; PSV 10343e, HOW-08-01; PSV 10345, HOW-05P-02; PSV 10356c, HOW-11P-02; PSV 10392b, HOW-10-01; PSV 10485, HOW-11P-04; PSV 10499, HOW-14P-04; PSV 10589, HOW-05P-04. Phoenix: Degener and Degener (1959), South et al. (2001).

Filaments 24–44 μm in diameter with distinct but colorless sheath materials. Most specimens represented by empty individual sheaths with few trichomes. Disc-shaped cells of the red, greenish brown, or green trichomes (12)16–28 μm in diameter and 2–4 μm long and possess rounded terminal cells with no caps.

Lyngbya majuscula (Dillwyn) Harvey

Howland: PSV 10239, HOW-13-02; PSV 10354a, HOW-11P-02. Phoenix: Degener and Degener (1959), South et al. (2001).

The two specimens are placed under this species with hesitation because the filaments and trichomes are quite thin (10–14 μm and 8–10 μm, respectively). Cells 1–2 μm long with rounded terminal cells and with no cap. Distinct packets of hormogones present in PSV 10239.

Lyngbya semiplena (C. Agardh) J. Agardh

Baker: PSV 10259h, BAK-13-02; PSV 10276f, BAK-10-01; PSV 10292a, BAK-15-02. Phoenix: Degener and Degener (1959), South et al. (2001).

Filaments 10–14 μm in diameter with trichomes within clear individual sheaths. Disc-shaped cells range from 5 to 7 μm in diameter and 2–4 μm long. The specimens are placed here with hesitation because the characteristic colorless caps on the rounded terminal cells are rare to absent.

Family Phormidiaceae

Blennothrix lyngbyacea (Kützing) Anagnostidis & Komarek

Baker: PSV 10266a, BAK-10-01. Phoenix: South et al. (2001).

Sheathless trichomes 8–10 μm in diameter and most cells 4 μm long. Terminal cells rounded; however, caps are absent.

Hydrocoleum coccineum Gomont

Baker: PSV 10557, BAK-09-04.

Sheathless trichomes 5.5–9.5 μm in diameter, and disc-shaped cells 2.5–6.0 μm long. Terminal cells rounded with caps rare or absent.

Family Pseudoanabaenaceae

Spirocoleus fragilis (Meneghini) P. Silva

Baker: PSV 10292b, BAK-15-02. Howland: PSV 10506, HOW-14P-04.

Extremely thin trichomes with obscure individual sheaths 1–1.5 μm in diameter, with length of cells approximately 2–2.5 times diameter. Terminal cells blunt with no caps.

Family Schizothrichaceae

Schizothrix calcicola (C. Agardh) Gomont

Baker: Tsuda and Trono (1968); PSV 10331a, BAK-05P-02.

Trichomes appear in bundles with cells 2–3 μm in diameter and one to two times the diameter in length.

Division Rhodophyta
Order Porphyridiales
Family Porphyridiaceae

Stylonema alsidii (Zanardini) Drew

Baker: PSV 10254a on fragment of *Chondria* sp., BAK-16P-02; PSV 10291b, 10298c, BAK-15-02. Howland: PSV 10247 on immature *Cladophora* sp., HOW-13-02.

Order Acrochaetiales
Family Acrochaetiaceae

Acrochaetium microscopicum (Nägeli ex Kűtzing) Nägeli

Baker: BISH 725333 (IA 25109a) on *Herposiphonia secunda*, Baker 1D.

Order Nemaliales
Family Galaxauraceae

Galaxaura filamentosa Chou

Baker: BISH 725338 (IA 25117), Baker 1E; PSV 10365, BAK-11A-01; PSV 10381, BAK-08-01; PSV 10520, BAK-11P-04; PSV 10542, BAK-05P-04; PSV 10577, BAK-02. Phoenix: South et al. (2001).

Order Gelidiales
Family Gelidiaceae

Pterocladiella caloglossoides (Howe) Santelices

Baker: PSV 10118c, BAK-14-02; PSV 10264, BAK-13-02; PSV 10268, BAK-10-01; PSV 10294, BAK-15-02; PSV 10526, BAK-11P-04; PSV 10543, BAK-05P-04. Howland: PSV 10482, HOW-11P-04. Phoenix: Dawson (1959*a*).

All specimens show distinctive peglike rhizoidal attachments on prostrate axis opposite the flattened erect axis up to 3 mm high.

Order Gracilariales
Family Gracilariaceae

Gracilaria sp.

Baker: PSV 10260, BAK-10-01; PSV 10552, 10552b, BAK-09-01.

Specimens straggly, up to 10 cm long, with subdichotomous branches. PSV 10552 possesses a thick cortex with pseudoparenchymatous medulla. PSV 10260 appears different externally, up to 4 cm tall, with slightly flattened (1 mm wide) dichotomous to subdichotomous branches.

Order Corallinales
Family Corallinaceae

Jania adhaerens Lamouroux

Howland: BISH 529204 (CRL 2333.2 as *Jania capillacea* Harvey in Tsuda and Trono [1968]); BISH 725348 (IA 25129), Howland 1B; BISH 725352 (IA 25132), BISH 725360 (IA 25142), BISH 725363 (IA 25145), Howland 1C.

Branches, decalcified and mounted on slides, 80–128 μm in diameter and possess one or two, rarely three, intergenicula between dichotomies. Specimen CRL 2333.2 was cited by Tsuda and Trono (1968) as a mixture of both *Jania capillacea* and *Jania micrarthrodia*. Reexamination of the Howland Island specimen indicated it to be more applicable to *Jania adhaerens.*

Jania pacifica Areschoug (= *Jania mexicana* Taylor)

Figure 2*A*

Baker: BISH 535327 (CRL 2165.1), beachdrift, south reef, VII-21-64, leg. C. R. Long; BISH 535539 (CRL 2165), beachdrift on south reef, VII-21-64, leg. C. R. Long. Howland: BISH 506215, Itasca Expedition, June 1935, leg. A. F. Judd and D. D. Mitchell; BISH 506218 (EC 24), Whippoorwill Expedition, west coast, IX-1924, leg. E. Christophersen; BISH 529227 (CRL 2324), in crevice on reef rock at NW Point, X-9-64, leg. C. R. Long; BISH 529231 (CRL 2324.2 as *Jania micrarthrodia* Lamouroux in Tsuda and Trono [1968]), in crevise on reef at NE Pt., X-9-64, leg. C. R. Long; BISH 535501 (CRL 2188.1), BISH 535540 (CRL 2188), beachdrift on west reef, VII-23-64, leg. C. R. Long; BISH 535541 (CRL 2190), exposed reef and reef pools on west reef, VII-23-64, leg. C. R. Long; BISH 708291, Whippoorwill Expedition, IX-1924, leg. E. Christophersen; PSV 10511a, HOW-16-04.

All specimens epilithic and can form clumps up to 1 cm tall. Branches, 140–400 μm in diameter, predominantly widely dichotomous with rounded apices and the genicula slightly constricted, with length to width ratio of 2–3.5 to 1. See Taylor's (1945) description of *Jania mexicana.* All specimens lacked mature conceptacles. Specimens very similar to *Jania rubens* (Linnaeus) Lamouroux; however, the Howland Island and Baker Island specimens have rounded, instead of pointed, apices. Specimens also similar to *Jania micrarthrodia* Lamouroux but possess more than two tiers of medullary cells in the intergenicula.

Jania micrarthrodia may not be present in the Howland marine flora as previously cited by Tsuda and Trono (1968). After reexamination of CRL 2324.2, the specimen previously reported as *Jania micrarthrodia* appears to be more applicable to *Jania pacifica*. CRL 2351.2 reported as *J. micrarthrodia* could not be found in the Bishop Museum Herbarium.

Jania pumila Lamouroux

Baker: Tsuda and Trono (1968) as *Jania capillacea* Harvey; BISH 725318 (IA 25006b), Baker 1A; PSV 10332b, BAK-05P-02. Howland: Tsuda and Trono (1968) as *Jania capillacea* Harvey; BISH 725355 (IA 25134b),

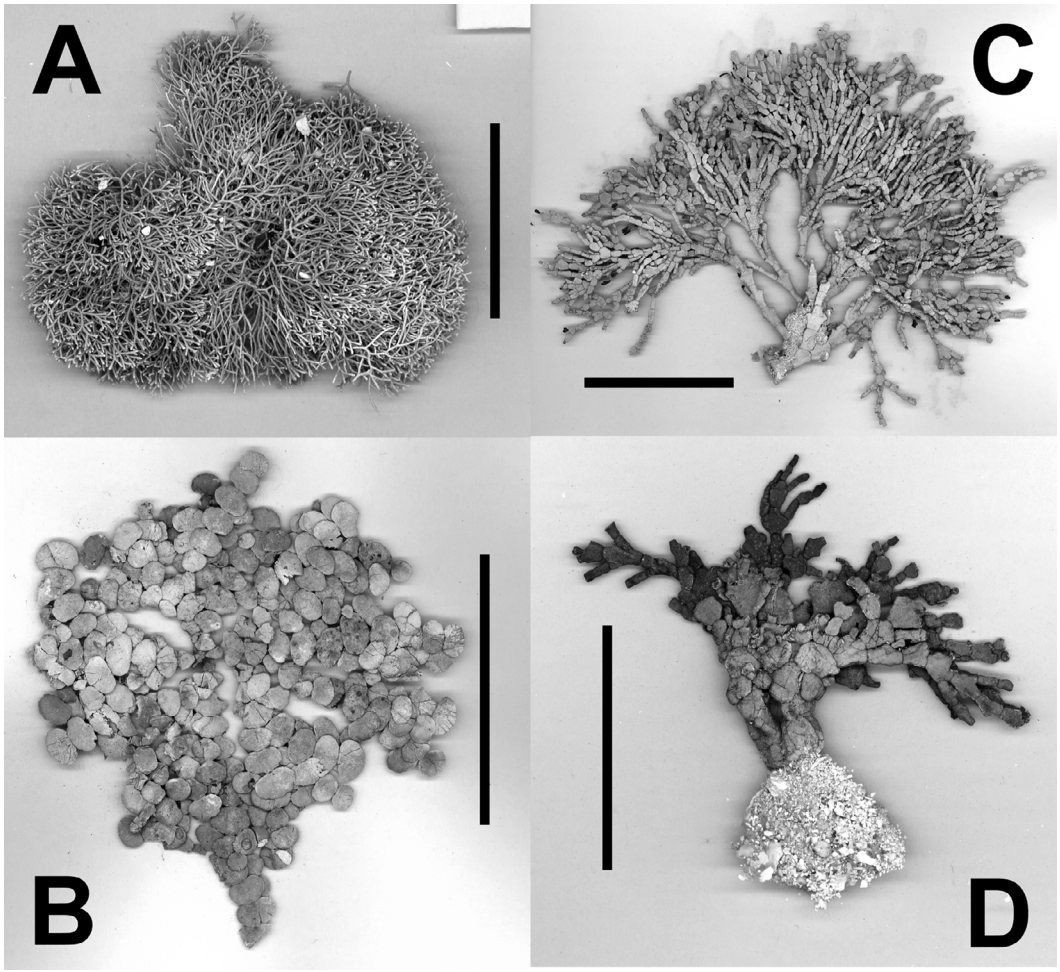

FIGURE 2. *A*, *Jania pacifica*, habit (BISH 535539), scale bar = 3 cm; *B*, *Halimeda fragilis*, habit (PSV 10536), scale bar = 6 cm; *C*, *Halimeda heteromorpha*, habit, without holdfast (PSV 10227), scale bar = 6 cm; *D*, *Halimeda heteromorpha*, habit, with holdfast (PSV 10118), scale bar = 5 cm.

Howland 1C; PSV 10232b, HOW-05P-02; PSV 10328f, HOW-07-01.

Branches, decalcified and mounted on glass slides, 72–80 μm in diameter with three or more intergenicula between dichotomies.

Order HALYMENIALES
Family HALYMENIACEAE

Cryptonemia sp.

Baker: PSV 10310, 1.5 cm long sterile blade, BAK-07-01.

Halymenia sp.

Baker: BISH 712195 (IA 25085), 4 cm long sterile blade, Baker 1Aa.

Order GIGARTINALES
Family HYPNEACEAE

Hypnea pannosa J. Agardh

Baker: BISH 725331 (IA 25106), BISH 725334 (IA 25110), Baker 1D; PSV 10277, BAK-05A-01; PSV 10313, BAK-07-01; PSV 10331, BAK-05P-02; PSV 10362, BAK-11A-

01; PSV 10378, BAK-08-01. Phoenix: South et al. (2001).

Hypnea spinella (C. Agardh) Kützing

Baker: Tsuda and Trono (1968) as *Hypnea* sp. (<1 cm fragment); BISH 506213 (EC 10), Whippoorwill Expedition, east beach, IX-1924, leg. E. Christophersen; BISH 725313 (KN 226a, IA 23414a) on *Dictyota friabilis*, Reef Flat; PSV 10579, BAK-02-04. Howland: BISH 725359 (IA 25141), Howland 1C; BISH 725367 (IA 25148), Howland 1D. Phoenix: Degener and Gillaspy (1955).

Hypnea sp.

Baker: BISH 725290 (KN 152), Station 1; BISH 725300 (KN 218, IA 23403) on dead coral, Station 2; PSV 10521, BAK-11P-04; PSV 10533, BAK-07-04; PSV 10538, BAK-05P-04.

Branches do not adhere to each other but are similar in diameter and appear like a straggly *Hypnea spinella*. At this time, we are keeping these specimens separate from those of *H. spinella*.

Family Peyssonneliaceae

Peyssonnelia inamoena Pilger

Baker: PSV 10259, BAK-13-02; PSV 10260a, 10272, 10276b, BAK-10-01; PSV 10385, BAK-08-01; PSV 10558, BAK-09-04; PSV 10581, 10585, BAK-02-04.

The yellow brown to dark red crusts loose and up to 3.5 cm broad.

Peyssonnelia sp.

Howland: PSV 10339, fertile, epilithic, HOW-08-01.

Monosporangia approximately 68 μm long and 24 μm wide and appear to be surrounded by paraphyses.

Order Rhodymeniales
Family Lomentariaceae

Gelidiopsis intricata (C. Agardh) Vickers

Baker: PSV 10566a, BAK-16P-04. Phoenix: Dawson (1959*a*), South et al. (2001).

Gelidiopsis sp. 1

Howland: Tsuda and Trono (1968); BISH 529206 (CRL 2333.1), drift on exposed beach rock at northwest point, X-10-64, leg. C. R. Long; BISH 506217, Itasca Expedition, VI-1935, leg. A. F. Judd and D. D. Mitchell.

Both CRL 2333.1 (BISH 529206) reported previously by Tsuda and Trono (1968) and BISH 506217 collected during the Itasca Expedition in June 1935 appear identical. Medullary cells 12–18 μm in diameter with cortical cells smaller at 8 μm in diameter.

Gelidiopsis sp. 2

Baker: BISH 531402 (CRL 2385b), shallow pool, northwest beach, X-14-64, leg. C. R. Long.

Specimens form extensive tangled clumps with erect terete branches (240–260 μm in diameter), unbranched or rarely branching, arising from a prostrate stolon (280 μm in diameter). In cross section, medullary cells 40–68 μm in diameter and cortical cells in outer row 16–20 μm in diameter.

Lomentaria hakodatensis Yendo

Baker: BISH 725301 (KN 219, IA 23404), Station 2; PSV 10281c, BAK-05A-01; PSV 10332c, BAK-05P-02; PSV 10361c, BAK-11A-01; PSV 10386e, BAK-08-01. Howland: PSV 10232c, HOW-05P-02; PSV 10241, HOW-13-02; PSV 10343c, HOW-08-01; PSV 10347a, HOW-05P-02; PSV 10592, tetrasporic, HOW-05P-04-Deep.

Specimens with arcuate prostrate and erect branches 180–240 μm in diameter, and cortical cells slightly elongated, 24–34 μm long by 6–8 μm wide. KN 219 is much wider (560 μm) and compressed.

Lomentaria sp.

Baker: Tsuda and Trono (1968) as *Lomentaria* sp.; PSV 10277f, BAK-05A-01; PSV 10366, tetrasporic, BAK-11A-01; PSV 10374, tetrasporic, BAK-11P-02. Howland: PSV 10323b, HOW-05P-01.

Branches slightly flattened, which differs from branches of the more commonly found *Lomentaria hakodatensis*.

Order Ceramiales
Family Ceramiaceae

Aglaothamnion boergesenii (Aponte & Ballantine) L'Hardy-Halos & Rueness

Baker: PSV 10297, 10298a, BAK-15-02.

Aglaothamnion cordatum (Børgesen) Feldmann-Mazoyer

Baker: PSV 10298f, BAK-15-02. Phoenix: South et al. (2001).

Anotrichium tenue (C. Agardh) Nageli

Howland: PSV 10352a, 10354b, HOW-11P-02. Phoenix: South et al. (2001).

Antithamnionella breviramosa (Dawson) Wollaston

Baker: PSV 10298h, BAK-15-02; PSV 10556, BAK-09-04.

Antithamnion antillanum Børgesen

Baker: PSV 10527a, epizoic on hydroid, BAK-11P-04.

Ceramium codii (Richards) G. Mazoyer

Baker: PSV 10277a, BAK-05A-01; PSV 10293, BAK-15-02; PSV 10361f, BAK-11A-01. Howland: PSV 10344a, HOW-05P-02.

The determinate erect axes possess four periaxial cells with nodes 20–32 μm in diameter and acropetal nodal development.

Ceramium flaccidum (Kützing) Ardisone

Baker: Tsuda and Trono (1968) as *Ceramium gracillimum* var. *byssoideum* (Harvey) G. Mazoyer; BISH 725303 (KN 220b, IA 23405b) on *Lobophora variegata*, Station 2; BISH 725304 (IA 23406a), Station 2; BISH 725307 (IA 23407b), Station 2; BISH 725321 (IA 25086) on *Halimeda heteromorpha*, tetrasporic, Baker 1B; BISH 725330 (IA 25105a) on *Hypnea pannosa*, Baker 1D; PSV 10277h on *Heterosiphonia crispella*, BAK-05A-01; PSV 10367, BAK-11A-01; PSV 10370a, BAK-11P-02; PSV 10393b, tetrasporic, Inshore from BAK-11A-01. Phoenix: Dawson (1959*a*), South et al. (2001).

Erect determinate axes 32–48 μm in diameter with unequal forcipate branch tips. Nodes possess space above the two lower rows of cortical cells.

Ceramium hanaense R. E. Norris & Abbott

Baker: PSV 10332a, BAK-05P-02.

Erect determinate axes 80–96 μm in diameter with tapering apices.

Ceramium macilentum J. Agardh

Baker: Tsuda and Trono (1968) as *Ceramium* sp.; PSV 10523 on *Cladophora* sp., BAK-11P-04; PSV 10554 on *Cladophora vagans*, BAK-09-04. Howland: Tsuda and Trono (1968) as *Ceramium* sp.; PSV 10232d, HOW-05P-02. Phoenix: South et al. (2001).

Filaments 72–96 μm in diameter with acropetal nodal development as described by South and Skelton (2000). Rhizoids possess terminal multicellular attachment pads.

Ceramium vagans Silva (= *Ceramium vagabundum* Dawson)

Baker: BISH 725305 (IA 23406d), BISH 725306 (IA 23407a), Station 2; BISH 725330 (IA 25105a), Baker 1D. Phoenix: Dawson (1959*a*).

Erect determinate axes 40–48 μm in diameter with triangular apices.

Ceramium sp.

Baker: PSV 10272d on *Pterocladiella caloglossoides*, BAK-10-01.

Sterile specimen predominantly prostrate with short padded rhizoids arising from nearly every node. Erect axes less than 1 mm long and 40 μm in diameter. Several specimens of this species, all epiphytic on *Pterocladiella caloglossoides*, were found in collections from Jarvis Island (Line Islands) and will be discussed in a future paper.

Corallophila apiculata (Yamada) R. E. Norris

Baker: BISH 725330 (IA 25105a), Baker 1D; PSV 10527b, BAK-11P-04.

Corallophila huysmansii (Weber-van Bosse) R. E. Norris

Baker: BISH 531402a (CRL 2385a), shallow pool, northwest beach, X-14-64, leg. C. R. Long; BISH 725304 (IA 23406a), Station 2; PSV 10259e, BAK-13-02. Howland: PSV 10238a on *Palmophyllum crassum*, HOW-13-02. Phoenix: South et al. (2001).

Corallophila itonoi (Ardré) R. E. Norris

Baker: BISH 725299 (KN 217c, IA 23402c) on *Lobophora variegata*, Station 2; BISH 725304 (IA 23406a), Station 2; PSV 10277b, BAK-05A-01; PSV 10313a, BAK-07-01; PSV 10373, BAK-11P-02. Howland: PSV 10324a, HOW-05P-01.

Erect axes 160–192 μm in diameter and thicker than erect axes of *C. huysmansii* (70–

88 μm) and *C. apiculata* (120–160 μm). Some tips possess forcipate terminal branches.

Crouania minutissima Yamada

Baker: PSV 10276c, 10276g, both tetrasporic, BAK-10-01. Phoenix: South et al. (2001).

Lejolisea pacifica Itono

Baker: PSV 10298e, BAK-15-02; PSV 10386f, BAK-08-01; PSV 10564, PSV 10566a, BAK-16P-04. Howland: PSV 10499a, HOW-14-04.

Ptilothamnion cladophorae (Yamada & Tanaka) Feldmann-Mazoyer

Baker: BISH 725318 (IA 25006b), Baker 1A; PSV 10531, BAK-07-04. Howland: BISH 725370 (IA 25153a), Howland 1E; PSV 10328g, HOW-07-01. Phoenix: South et al. (2001).

Cells of erect unbranched axes 20–24 μm in diameter and 5–6 diameters long. Rhizoids with digitate ends arise opposite erect axes.

Wrangelia anastomosans Yamada

Baker: BISH 725316 (KN 231, IA 23421), Reef Flat; BISH 725319 (IA 25084), Baker 1A; BISH 725320 (IA 25085a), Baker 1Aa; PSV 10314, BAK-07-01; PSV 10361, BAK-11A-01. Howland: BISH 725343 (KN 227, IA 23415), Reef Flat; BISH 725347 (IA 25128), Howland 1A; BISH 725350 (IA 25152), Howland 1Ba; BISH 725366 (IA 25147), Howland 1D; PSV 10124, HOW-11P-02; PSV 10229, HOW-15-02; PSV 10234a, HOW-14P-02; PSV 10325, HOW-05P-01; PSV 10328a, HOW-07-01; PSV 10340, 10343, HOW-08-01; PSV 10349, HOW-05P-02; PSV 10356d, HOW-11P-02; PSV 10389, HOW-10-01; PSV 10484, HOW-11P-04; PSV 10489, HOW-05P-04; PSV 10497, HOW-14P-04; PSV 10512, HOW-16-04; PSV 10591, HOW-17-04; PSV 10598, HOW-11P-04.

Specimens up to 6 cm high and most four times pinnately branched with pinnules as described by Yamada (1944). Most specimens tetrasporangial; few male and female gametophytes present.

Family Dasyaceae

Dasya kristeniae Abbott

Baker: PSV 10298i, BAK-15-02.

Dasya sp.

Howland: BISH 725369 (IA 25153), Howland 1E.

Uncorticated main axis 5 mm high and about 100 μm in diameter.

Heterosiphonia crispella (C. Agardh) Wynne

Baker: BISH 725302 (KN 220a, IA 23405a) on *Lobophora variegata*, Station 2; PSV 10271c, BAK-10-01; PSV 10277d, BAK-05A-01; PSV 10371c with *Herposiphonia obscura*, BAK-11A-01. Howland: PSV 10306c, 10309b, HOW-07-01. Phoenix: South et al. (2001).

Family Sarcomeniaceae

Cottoniella filamentosa (Howe) Børgesen

Baker: PSV 10269, 10270, 10271, 10275a, BAK-10-01; PSV 10304, BAK-15-02; PSV 10553, tetrasporic, BAK-09-04.

Family Rhodomelaceae

Chondria simpliciuscula Weber-van Bosse

Baker: BISH 528565 (CRL 2170), VII-21-64, leg. C. R. Long; PSV 10393d, Inshore from BAK-11P-02. Howland: BISH 535329 (CRL 2190.2) with *Jania pacifica*, exposed reef and reef pools, west reef, VII-23-64, leg. C. R. Long.

Chondria sp.

Baker: PSV 10569, 10571, BAK-16P-04.

Specimens possess both erect prostrate and erect components. Branches 175–280 μm in diameter with apices attenuate and exerted. Trichoblasts conspicuous at apices. South et al. (2001) reported *Chondria repens* Børgesen from the Phoenix Group.

Digenea simplex (Wulfen) C. Agardh

Baker: PSV 10298d, BAK-15-02.

Herposiphonia obscura Hollenberg

Baker: PSV 10371b with *Heterosiphonia crispella*, BAK-11P-02.

Unbranched determinate erect axes with less than 20 segments per erect branch, which alternate with immature indeterminate erect axes on prostrate axes.

Herposiphonia parca Setchell

Howland: PSV 10243, HOW-13-02; PSV 10353a, HOW-11P-02.

Three determinate erect axes alternate with one immature indeterminate erect axis on the prostrate axes. Determinate axes consist of eight pericentral cells per segment with 12–14 segments per erect branch.

Herposiphonia secunda (C. Agardh) Ambronn (= *Herposiphonia tenella* [C. Agardh] Schmitz)

Baker: IA 25109a with *Acrochaetium microscopicum*, Baker 1D. Phoenix: Degener and Gillaspy (1955), Dawson (1959*a*).

Arrangement of determinate and indeterminate axes similar to arrangement in *Herposiphonia parca;* however, erect branches of *H. secunda* have up to 45 segments, less than eight pericentral cells, and are slimmer (approximately 32 μm in diameter).

Laurencia majuscula (Harvey) Lucas

Baker: BISH 725311 (KN 224, IA 23412), Reef Flat; BISH 725325 (IA 25090), Baker 1B; PSV 10121, BAK-Reef Flat-02; PSV 10393c, Inshore from BAK-11A-01. Howland: BISH 725356 (IA 25138), Howland 1C; BISH 725358 (IA 25140), Howland 1C.

Specimens red, terete, soft, and occur in clumps. Anatomically, cortical cells of specimens project from surface and there is no visible lenticular thickening in walls of medullary cells.

Laurencia mariannensis Yamada

Howland: BISH 725344 (KN 228, IA 23418), BISH 725345 (KN 229, IA 23419), Reef Flat.

This species also occurs in clumps but differs anatomically from *Laurencia majuscula* by presence of lenticular thickenings in walls of medullary cells.

Neosiphonia savatieri (Hariot) Masuda & Kogame

Baker: PSV 10316a, BAK-09-04.

Prostrate axes possess scar cells and erect branched axes 60–64 μm in diameter at apices and wider (120–160 μm in diameter) at basal sector. Length of pericentral cells equal to or shorter than their width.

Polysiphonia apiculata Hollenberg

Baker: PSV 10298b, BAK-15-02.

Polysiphonia delicatula Hollenberg

Baker: PSV 10291c, BAK-15-02.

Erect axes minute, 36–40 μm in diameter, and possess tapered apices with no trichoblasts. Digitate rhizoids cut off from pericentral cells but remain intact.

Polysiphonia homoia Setchell & Gardner

Baker: PSV 10277e, BAK-05A-01.

The predominantly erect axes approximately 200 μm in diameter possess five pericentral cells.

Polysiphonia scopulorum Harvey

Baker: BISH 725328 (IA 25102), Baker 1C; PSV 10280, BAK-05A-01; PSV 10312a, BAK-07-01; PSV 10333, BAK-05P-02; PSV 10386g, BAK-08-01; PSV 10519, BAK-11P-04; PSV 10527b, BAK-11P-04. Phoenix: Hollenberg (1968*a*).

Specimens consist of 3 mm high tufts. Erect axes 24–40 μm in diameter with four pericentral cells and digitate rhizoids in direct connection to pericentral cells.

Polysiphonia triton Silva (= *Polysiphonia tenuis* Hollenberg)

Baker: PSV 10556, BAK-09-04; PSV 10565, BAK-16P-04.

Erect unbranched axes 32–40 μm in diameter, with length of each of four pericentral cells equal to or slightly longer than their width. Scar cells not visible on erect axes. Rhizoids cut off from pericentral cells but remain intact.

Division Ochrophyta
Order Ectocarpales
Family Scytothamnaceae

Asteronema breviarticulatum (J. Agardh) Ouriques & Bouzon

Baker: BISH 506199 (EC 3), Itasca Expedition, west beach, VI-1935, leg. A. F. Judd and D. D. Mitchell.

Order Dictyotales
Family Dictyotaceae

Dictyopteris repens (Okamura) Børgesen

Baker: BISH 725297 (KN 217a, IA 23402a), Station 2. Howland: PSV 10348a, HOW-05P-02. Phoenix: Dawson (1959*a*), South et al. (2001).

Dictyota friabilis Setchell

Baker: BISH 725314 (KN 226b, IA 23414b), matted with *Hypnea spinella*, Reef Flat; PSV 10313b, BAK-07-01. Howland: Tsuda and Trono (1968). Phoenix: Dawson (1959*a*), South et al. (200l).

Dictyota sandvicensis Sonder

Baker: BISH 725293 (KN 153), Station 1; BISH 725335 (IA 25111), Baker 1D; PSV 10277c, BAK-05A-01; PSV 10361e, BAK-11A-01; PSV 10377, BAK-08-01; PSV 10518, BAK-11P-04; PSV 10530, BAK-07-04; PSV 10539, BA-05P-04; PSV 10575, BAK-02-04. Howland: PSV 10228, HOW-05P-02; PSV 10326, HOW-05P-01; PSV 10350, HOW-05P-02; PSV 10493, HOW-05P-04; PSV 10588, HOW-05P-04-Deep.

Specimens up to 2 cm high and possess characteristic greenish brown color. Spatulate bladelets along margin characteristic of this species; however, bladelets few and not as evident as in Hawaiian specimens. PSV 10518 is the only specimen with several distinct spatulate bladelets.

Lobophora variegata (Lamouroux) Womersley ex Oliveira

Baker: BISH 725298 (KN 217b, IA 23402b), Station 2; BISH 725315 (KN 226c, IA 23414c), Reef Flat; BISH 725327 (IA 25096), Baker 1C; BISH 725341 (IA 25122), Baker 1E; PSV 10115, BAK-11P-02; PSV 10278, BAK-05A-01; PSV 10311, BAK-07-01; PSV 10329, BAK-05P-02; PSV 10359, 10368, BAK-11A-01; PSV 10369, BAK-11P-02; PSV 10376, BAK-08-01; PSV 10522, BAK-11P-04; PSV 10528, BAK-07-04; PSV 10537, BAK-05P-04; PSV 10548, BAK-09-04; PSV 10580, BAK-02-04. Howland: BISH 725365 (IA 25146b), BISH 725368 (IA 25150), Howland 1D; PSV 10261, HOW-09-01; PSV 10307, HOW-07-01; PSV 10324, HOW-05P-01; PSV 10338, HOW-08-01; PSV 10352c, HOW-11P-02; PSV 10391, HOW-10-01; PSV 10481, HOW-11P-04; PSV 10492, HOW-05P-04; PSV 10500, HOW-14P-04; PSV 10509, HOW-16-04; PSV 10587, HOW-17-04; PSV 10594, HOW-11P-04. Phoenix: Dawson (1959*a*), South et al. (2001).

Padina sp.

Baker: BISH 725294 (KN 153b), Station 1.

Specimens consist only of branching vaughaniella stage with immature blades absent. It is interesting that this common tropical genus was not reported from Howland Island or Baker Island by Tsuda and Trono (1968), nor from nearby islands in the Phoenix Group by Degener and Gillaspy (1955), Dawson (1959*a*), and South et al. (2001).

Order Fucales
Family Sargassaceae

Turbinaria ornata (Turner) J. Agardh

Baker: Tsuda and Trono (1968); BISH 506176, Itasca Expedition, VI-1935, leg. A. F. Judd and D. D. Mitchell; PSV 10317, BAK-09-04; PSV 10576, BAK-02-04. Phoenix: Degener and Gillaspy (1955), Dawson (1959*a*), Taylor (1964), South et al. (2001).

BISH 506176 appears similar to Taylor's (1964) description of *Turbinaria ornata* var. *ornata* f. *evesiculosa* (Barton) Taylor (the specimen, 7 cm tall, lacks intramarginal crown and vesicles). PSV 10317 and PSV 10576 consist only of secondary haptera with development of immature erect structures. *Turbinaria ornata* is the only species of the genus reported from Baker Island and from the Phoenix Group.

Division Chlorophyta
Order Chlorococcales
Family Palmellopsidaceae

Palmophyllum crassum (Naccari) Rabenhorst

Baker: PSV 10298g, BAK-15-02. Howland: PSV 10238b, HOW-13-02; PSV 10495, HOW-05P-04.

Order Ctenocladales
Family Ulvellaceae

Ulvella lens P. Crouan & H. Crouan

Howland: BISH 725353 (IA 25133a) on *Cladophoropsis sundanensis*, Howland 1C.

Epiphytes discoid and orbicular, 100 μm in diameter, as per Abbott and Huisman (2004). Inner radiating cells spherical (6 μm in diam-

eter), and outer cells elongate (2 μm wide and 10 μm long).

Order Ulvales
Family Ulvaceae

Ulva clathrata (Roth) C. Agardh (= *Enteromorpha clathrata* (Roth) Greville)

Baker: PSV 10279, BAK-05A-01. Howland: PSV 10356a, HOW-11P-02. Phoenix: Dawson (1959*a*).

All specimens less than 1 cm high with uniseriate and multiseriate branchlets present throughout length. Cells clearly aligned longitudinally and possess pyrenoids. PSV 10356a is an immature uniseriate filament approximately 1 mm long.

Ulva fasciata Delile

Baker: Tsuda and Trono (1968). Howland: Tsuda and Trono (1968); PSV 10277j on *Hypnea pannosa*, HOW-05P-01.

Immature blades 2.5 cm long, two cells thick throughout, and 56–72 μm thick. Cells taller than broad.

Ulva rigida C. Agardh

Baker: BISH 725332 (IA 25107), Baker 1D; PSV 10277j, BAK-05A-01.

Immature dark green specimens, up to 5 mm tall and 56–64 μm thick, possess holdfasts and unruffled blades with few fine marginal spines.

Order Cladophorales
Family Anadyomenaceae

Microdictyon setchellianum Howe

Baker: PSV 10302, BAK-15-02; PSV 10584, BAK-02-04.

Specimens netlike in one plane; cells 220–280 μm wide with length approximately 1.5 times width. Mesh varies in size (200–440 μm at largest diameter). Cell walls of anastomosing segments primarily unmodified with crenulations rare, as described by Egerod (1952).

Family Cladophoraceae

Cladophora boodleoides Børgesen

Baker: Tsuda and Trono (1968) as *Cladophora* sp. (CRL 2369.4); PSV 10255, BAK-16P-02; PSV 10523, BAK-11P-04. Phoenix: South et al. (2001).

The rarely branched main filaments consist of cells 136–200 μm in diameter and 280–480 μm long. Characteristic feature of filaments is rhizoidlike pigmented branches, 56 μm in diameter and up to 700 μm long, that possess rounded or digitate tips. Branches arise adjacent to and above septa of main filament. The 1 cm long immature beachdrift (CRL 2369.4) reported by Tsuda and Trono (1968) appears to be applicable to this species.

Cladophora coelothrix Kützing

Baker: PSV 10534, BAK-07-04.

Specimens seem similar to this species as described by Van den Hoek (l963). Erect predominantly unbranched filaments, 4 mm high and 24–32 μm in diameter, arise from a prostrate filament that possesses rhizoids with digitate tips. Cells elongated and have length to diameter ratio of 5–6 to 1.

Cladophora vagabunda (Linnaeus) Hoek

Baker: PSV 10299, BAK-15-02; PSV 10386b, BAK-08-01; PSV 10544, BAK-05P-04. Howland: BISH 725357 (IA 25139), Howland 1C.

All immature filaments less than 1 cm long with cells 96–120 μm in diameter.

Rhizoclonium implexum (Dillwyn) Kützing

Baker: PSV 10359a, BAK-11A-01.

Uniseriate unbranched filaments form turfs, 2 mm high. Cells 20–32 μm in diameter with length approximately five times diameter.

Family Siphonocladaceae

Boodlea vanbosseae Reinbold

Baker: PSV 10295, BAK-15-02.

Unicellular rhizoids conspicuous on the fragmentary, 4 mm long, specimen.

Cladophoropsis gracillima Dawson

Baker: Tsuda and Trono (1968); BISH 725309 (KN 222, IA 23410), Reef Flat; BISH 725323 (IA 25088), BISH 725324 (IA 25089), BISH 725326 (IA 25091), Baker 1B; BISH 725339 (IA 25120), Baker 1E. Howland: Tsuda and Trono (1968). Phoenix: Dawson (1959*a*).

Leliaert and Coppejans (2006) considered *C. gracillima* of doubtful taxonomic affinity to the genus *Cladophoropsis* and did not consider the species in the taxonomic revision of *Cladophoropsis* sensu stricto because it lacked calcium oxalate crystals and had chloroplasts with up to four pyrenoids. Our specimens form circular cushions up to 4 cm in diameter, lack crystals, and possess long siphonlike cells whose length is greater than 15 times their diameter, rarely branched, 120–200 μm in diameter. Diameters of the siphonlike cells greater than of those specimens (65–100 μm) reported from Mexico (Dawson 1950, type), Arno (Dawson 1956) (70–100 μm), and Enewetak (Dawson 1957) (40 μm).

Cladophoropsis sundanensis Reinbold

Howland: BISH 725354 (IA 25133b), BISH 725361 (IA 25143), Howland 1C; BISH 725364 (IA 25146), Howland 1D. Phoenix: Dawson (1959*a*).

Soft light green turf consists of fine filaments with short nonseptate branches. Cells 160–180 μm in diameter with lengths usually less than eight times diameter.

Dictyosphaeria cavernosa (Forsskål) Børgesen

Baker: Tsuda and Trono 919680; BISH 725322 (IA 25087), Baker 1B; PSV 10257, BAK-Reef Flat-02; PSV 10316, BAK-09-01; PSV 10332, BAK-05P-02; PSV 10379, BAK-08-01; PSV 10524, BAK-11P-04; PSV 10547, BAK-09-04; PSV 10560, BAK-16P-04. Howland: Tsuda and Trono (1968); BISH 725351 (IA 25131), Howland 1C; PSV 10233, HOW-05P-02; PSV 10258, HOW-09-01; PSV 10308, HOW-07-01; PSV 10341, HOW-08-01; PSV 10346, HOW-05P-02; PSV 10354, 10355, HOW-11P-02; PSV 10387, HOW-10-01; PSV 10487, 10597, HOW-11P-04. Phoenix: Degener and Gillaspy (1955), Dawson (1959*b*), South et al. (2001).

Dictyosphaeria versluysii Weber-van Bosse

Baker: PSV 10118b, BAK-14-02. Phoenix: South et al. (2001).

Family Valoniaceae

Valonia utricularis (Roth) C. Agardh

Baker: BISH 725310 (KN 223, IA 23411), Reef Flat. Howland: PSV 10328b, HOW-07-01.

Specimens consist of less than 10 attached vesicles, each less than 6 mm long, and are placed here tentatively based on irregular size and subclavate shape of vesicles, and absence of trabeculae.

Ventricaria ventricosa (J. Agardh) Olsen & West

Baker: BISH 725308 (IA 23408), 1.5 mm diameter (immature), Station 2.

Order Bryopsidales
Family Bryopsidaceae

Bryopsis pennata Lamouroux

Baker: BISH 725296 (KN 216, IA 23401), Station 2; BISH 725312 (KN 225, IA 23413), Reef Flat; PSV 10281d, BAK-05A-01; PSV 10361b, BAK-11A-02; PSV 10372, BAK-11P-02; PSV 10525, BAK-11P-04; PSV 10535, BAK-07-04; PSV 10540, BAK-05P-04; PSV 10574, BAK-02-04. Howland: BISH 506214 (EC 23), Whippoorwill Expedition, west coast, IX-1924, leg. E. Christophersen. Phoenix: Dawson (1959*a*), South et al. (2001).

Family Caulerpaceae

Caulerpa serrulata (Forsskål) J. Agardh

Baker: PSV 10551, BAK-09-04; PSV 10572, BAK-02-04. Howland: Tsuda and Trono (1968) as *Caulerpa serrulata* var. *typical* f. *serrulata* (Weber-van Bosse) Gilbert; BISH 506195, Whippoorwill Expedition, west coast, IX-1924, leg. E. Christophersen; BISH 506203, Itasca Expedition, VI-27-35, leg. A. F. Judd and D. D. Mitchell; PSV 10231, HOW-05P-02; PSV 10306, HOW-07-01; PSV 10327, HOW-05P-01; PSV 10348, HOW-05P-02; PSV 10357, HOW-11P-02; PSV 10486, HOW-11P-04; PSV 10491, HOW-05P-04; PSV 10510, HOW-16-04; PSV 10590, HOW-17-04; PSV 10596, HOW-11P-04. Phoenix: Degener and Gillaspy (1955), Dawson (1959*a*), South et al. (2001).

Caulerpa webbiana Montagne

Baker: BISH 725340 (IA 25121), Baker 1E; PSV 10301, BAK-15-02. Howland: PSV 10390, HOW-10-01.

Family Codiaceae

Codium edule Silva
Baker: PSV 10281b, BAK-05A-01.

Family Derbesiaceae

Derbesia tenuissima (Moris & De Notaris) P. Crouan & H. Crouan
Baker: BISH 725305 (IA 23406d), Station 2.

Family Halimediaceae

Tsuda and Trono (1968) reported *Halimeda* spp. from Howland Island and Baker Island but did not list any species.

Halimeda fragilis W. R. Taylor
Figure 2*B*

Baker: BISH 725291 (KN 152a), Station 1; BISH 725317 (IA 23438), Reef Flat; BISH 725336 (IA 25113), Baker 1E; PSV 10116, BAK-13-02; PSV 10117, BAK-14-02; PSV 10120, BAK-15-02; PSV 10253, BAK-16P-02; PSV 10276, BAK-10-01; PSV 10292, BAK-15-02; PSV 10315, BAK-07-01; PSV 10319, BAK-09-01; PSV 10360, BAK-11A-01; PSV 10371, BAK-11P-02; PSV 10380, BAK-08-01; PSV 10536, BAK-07-04; PSV 10549, BAK-09-04; PSV 10559, BAK-16P-04; PSV 10582, BAK-02-04. Howland: BISH 725346 (KN 230, IA 23420), Reef Flat; BISH 725362 (IA 25144a), Howland 1C; PSV 10125, HOW-11P-02; PSV 10126, HOW-12-02; PSV 10232, HOW-15-02; PSV 10236, HOW 14P-02; PSV 10238, HOW-13-02; PSV 10248, HOW-12-02; PSV 10259, HOW-09-01; PSV 10309, HOW-07-01; PSV 10323, HOW-05P-01; PSV 10335, HOW-08-01; PSV 10344, HOW-05P-02; PSV 10356, HOW-11P-02; PSV 10388, HOW-10-01; PSV 10483, HOW-11P-04; PSV 10490, HOW-05P-04; PSV 10498, HOW-14P-04; PSV 10513, HOW-16-04; PSV 10586, HOW-17-04; PSV 10593, HOW-11P-04. Phoenix: Dawson (1959*a*).

Medullary filaments separate and not fused. Periphery utricles 28–44 μm in diameter, rounded in surface view and separate easily on decalcification. Macroscopically, some specimens appear similar to *Halimeda velasquezii* as described by Taylor (1962); however, branches grow in more than one plane in *Halimeda fragilis*. One of the 14 specimens on one sheet (PSV 10549) has a broadened basal segment, 1 cm wide, with branches arising from basal segment (similar to *Halimeda micronesica* Yamada).

Halimeda heteromorpha N'Yeurt
Figures 2*C*,*D*

Baker: BISH 725292 (KN 152c), Station 1; BISH 725295 (KN 216b), Station 2; BISH 725329 (IA 25148), Baker 1C; BISH 725342 (IA 25125), Baker 1E; PSV 10118, PSV 10227, BAK-14-02; PSV 10275, BAK-10-01; PSV 10318, BAK-09-01; PSV 10550, BAK-09-04. Phoenix: South et al. (2001) as *Halimeda incrassata* (Ellis) Lamouroux.

Specimens, up to 20 cm high, basically lack bulbous holdfasts; however, few specimens possess distinct bulbous holdfasts. Anatomically, medullary siphons and peripheral utricles appear similar to those of specimens within the Section *Rhipsalis* (Hillis-Colinvaux 1980, Verbruggen et al. 2005). Specimens appear similar to *Halimeda incrassata* (Ellis) Lamouroux, which is now considered an Atlantic species (Kooistra et al. 2002, Verbruggen et al. 2006).

Halimeda melanesica Valet
Figure 3*A*

Baker: PSV 10114, BAK-11P-02; PSV 10119, 10291, BAK-15-02; PSV 10256, BAK-Reef Flat-02; PSV 10393, Inshore from BAK-11A-01; PSV 10583, BAK-02-04.

Specimens are up to 11 cm high with small segments, 5–6 mm long and 3–5 mm wide, and nonbulbous holdfasts (Figure 3*A*). Medullary siphons adhere to each other; in a few cases, pores are visible under the microscope (×40). Cortex consists of mostly three tiers of utricles; peripheral utricles in surface view angular in shape and range from 36 to 52 μm in diameter and up to 76 μm long.

Specimens appear morphologically similar to *Halimeda simulans* Howe (Hillis-Colinvaux 1980); however, *H. simulans* is now considered an Atlantic species (Kooistra et al. 2002,

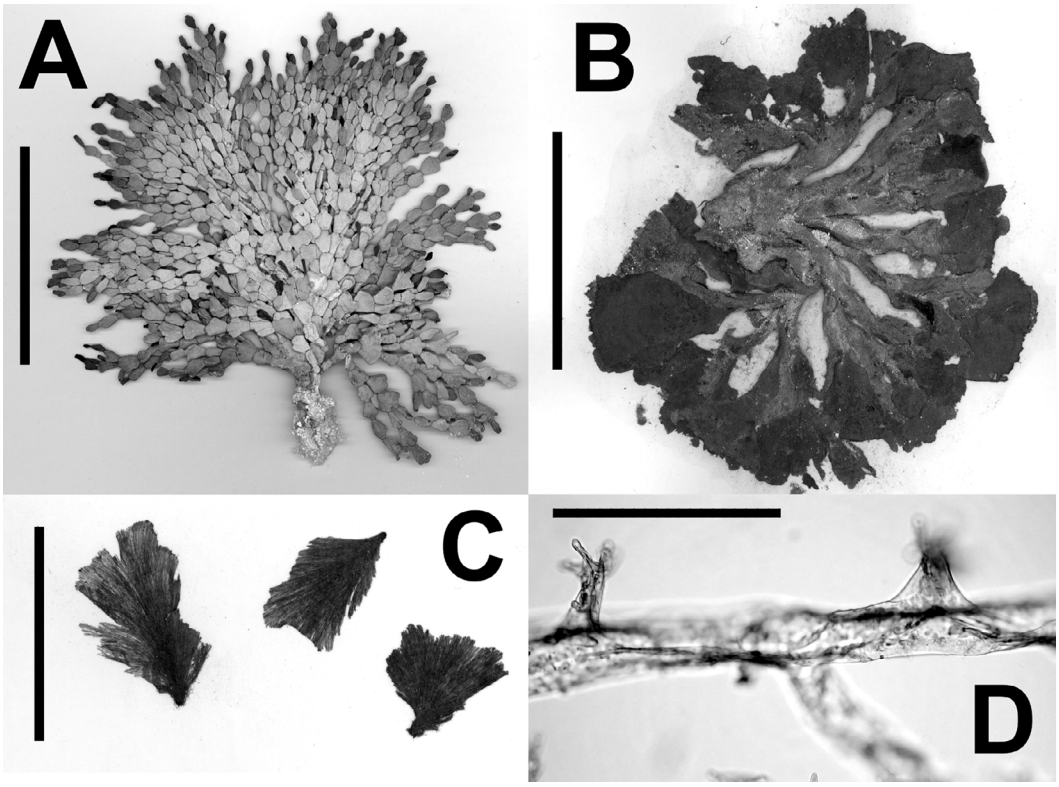

FIGURE 3. *A, Halimeda melanesica*, habit (PSV 10119), scale bar = 6 cm; *B*, *Avrainvillea lacerata*, habit (PSV 10511), scale bar = 6 cm; *C*, *Udotea palmetta*, habit (PSV 10578), scale bar = 3 cm; *D*, *Udotea palmetta*, lateral appendages on siphons (PSV 10578), scale bar = 200 μm.

Verbruggen et al. 2005). Specimens seem to fall within the recircumscription of *Halimeda melanesica* as presented by Verbruggen et al. (2006).

Family UDOTEACEAE

Avrainvillea amadelpha (Montague) A. Gepp & E. Gepp

Howland: BISH 506197, BISH 506198, BISH 529245, Itasca Expedition, northwest coast, VI-27-35, leg. A. F. Judd and D. D. Mitchell.

Specimens brown and up to 9 cm high. Holdfast consists of extensive emergent mats and narrow blades, 0.5–1.5 cm wide. Siphons cylindrical to torulose, 20–28 μm in diameter. Howland specimens resemble photograph of specimen from Tahiti in Olsen-Stojkovich (1985).

Avrainvillea lacerata Harvey ex J. Agardh
Figure 3*B*

Howland: BISH 725349 (IA 25130), Howland 1Ba; PSV 10237, HOW-14P-02; PSV 10251, HOW-12-02; PSV 10328, HOW-07-01; PSV 10342, HOW-08-01; PSV 10347, HOW-05P-02; PSV 10352, HOW-11P-02; PSV 10480, HOW-11P-04; PSV 10501, HOW-14P-04; PSV 10511, HOW-16-04; PSV 10595, HOW-11P-04.

Specimens up to 8.5 cm high and branching. Thin nonspongy blades consist of cylindrical and torulose siphons (8)12–16(24) μm in diameter; dichotomies may possess deep and long constrictions. No developed pseudocortex evident (Olsen-Stojkovich 1985). Most specimens possess matted holdfasts;

TABLE 1

Number of Species Recently Reported from Baker Island and Howland Island, with Number of New Records for the Two Islands

Division	Baker	Howland	Total	Phoenix	New Records How/Bak
Cyanophyta	6	3	7	4	6
Rhodophyta	49	24	56	16	53
Ochrophyta	7	4	7	4	5
Chlorophyta	24	16	29	10	25
Total	86	47	99	34	89

Note: Numbers shown under the heading "Phoenix" represent the number of species common to both the Phoenix Group and Baker (Bak) and Howland (How) Islands. The numbers do not include the five species (two Rhodophyta, two Ochrophyta, and one Chlorophyta) that were not recollected.

PSV 10342 and PSV 10511 possess bulbous holdfasts that give rise to branched stipes with blades.

Siphonogramen abbreviata (Gilbert) Abbott & Huisman

Howland: PSV 10248f, HOW-12-02; PSV 10392d, HOW-10-01.

Specimens possess short dichotomous branches above (terminal sector 32–56 μm in diameter and branches up to 560 μm long). Diameters of upper branches larger than those of Hawaiian specimens as described in Abbott and Huisman (2004).

Udotea palmetta Decaisne

Figure 3*C,D*

Baker: PSV 10578, BAK-02-04.

Thin fan-shaped blades, 2–4 cm long, calcified, and possess simple and compound lateral appendages aligned on one side of siphons, 32–48 μm in diameter, as illustrated in Gepp and Gepp (1911). Macroscopically, specimens similar in appearance to *Rhipidosiphon javensis* Montagne and the flabellate form of *Tydemania expeditionis* Weber-van Bosse; however, the two species do not possess the lateral appendages on the siphons. *Udotea palmetta* has been reported previously from Arno Atoll, Enewetak Atoll, Kwajalein Atoll, and Majuro Atoll in the Marshall Islands (Dawson 1956, 1957).

DISCUSSION

This study of marine benthic algae yielded 99 species, 47 and 86 species (Table 1) from Howland Island and Baker Island, respectively. Eighty-nine (six blue-greens, 53 reds, five browns, and 25 greens) of the 99 species are new records for the two islands. The total number of marine benthic algae from the islands increases to 104 species. Only four of the 20 species reported by Tsuda and Trono (1968) were not recollected: *Ulva kylinii* (Bliding) Hayden, Blomster, Maggs, P. C. Silva, M. J. Stanhope & J. R. Waaland (= *Enteromorpha kylinii* Bliding), *Hincksia indica* (Sonder) J. Tanaka (= *Ectocarpus indicus* Sonder), and *Sphacelaria* sp. from Baker Island, and *Laurencia caraibica* P. Silva (= *L. nana* Howe) from both Baker and Howland Islands. *Herposiphonia dendroidea* reported from Howland Island by Hollenberg (1968*c*) was also not recollected. All five species were recorded from the Phoenix Group (Dawson 1959*a*, Hollenberg 1968*c*, South et al. 2001).

The 47 species from Howland Island consist of three blue-greens, 24 reds, four browns, and 16 greens. The 86 species reported from Baker Island are nearly double that known from Howland Island and include six blue-greens, 49 reds, seven browns, and 24 greens. Collecting efforts on each island appear to be similar: 29 stations on Baker Island and 24 stations on Howland Island. The October 1964 algal collections on which Tsuda and Trono (1968) was based revealed greater species diversity from Baker Island: 16 species versus 10 species around Howland Island.

Wrangelia anastomosans was very prevalent (19 stations) at Howland Island but of rare occurrence (five stations) at Baker Island. *Halimeda heteromorpha* occurred in dense

patches at Baker Island but was never seen at Howland Island. The macroalgae *Galaxaura filamentosa*, *Hypnea pannosa*, and *Turbinaria ornata* were frequently encountered at Baker Island but were never encountered at Howland Island. *Avrainvillea lacerata* was common at Howland Island but absent at Baker Island.

South et al. (2001) commented that a good number of the 21 taxa of marine benthic algae (two varieties of *Caulerpa serrulata* included) reported by Tsuda and Trono (1968) were different from the 69 taxa recently reported from the Phoenix Group. When one compares the 104 species reported from Howland and Baker Islands and the 107 species, thus far, reported from the nearby Phoenix Group, the marine flora composition still remains different. Only 38% (39 of 104 species) of the specimens reported from Howland Island and Baker Island are known from the Phoenix Group. The red algae, 31% (18 of 58 species), and the green algae, 37% (11 of 30 species), are the least similar. Slightly more than half of the species of blue-greens, 57% (four of seven species), and brown algae, 67% (six of nine species), from Howland and Baker Islands were the same as those from the Phoenix Group.

The presence of *Udotea palmetta* on Baker Island is of phytogeographic interest because this record represents the first for the green algal genus in the central tropical Pacific. The records of both *Avrainvillea amadelpha* and *A. lacerata* are likewise noteworthy because the only other record of the genus *Avrainvillea* in the central tropical Pacific is from Palmyra Atoll in the Line Islands (Dawson et al. [1955], *Avrainvillea* sp.; Dawson [1959*b*], *A. lacerata*).

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Appendix

Collection Sites

Baker Island

U.S. Fish and Wildlife Service
Station 1, West southwest corner, 15.2 m deep, leg. K. B. Foster, III-7-98 (BISH 725290–725294).
Station 2, South southwest corner, 9.1 m deep, leg. K. B. Foster, III-7-98 (BISH 725295–725308).

Reef Flat, South southwest shoreline, <0.6 m, leg. K. B. Foster, III-7-98 (BISH 725309–725317).

National Marine Fisheries Service

Two different identification schemes were used for stations. The first scheme identified collecting stations 1A to 1E. The second scheme identified the islands, permanent stations, and year of collection: e.g., the designation "BAK-05P-04" signifies Baker Island (BAK), permanent station or site number (05P), and the year 2004, when the specimens were collected (04).

Baker 1A, north side, leg. R. Newbold, III-18-00 (BISH 725318, 725319).

Baker 1Aa, east side, leg. R. Newbold, III-19-00 (BISH 712195, 725320).

Baker 1B, reef flat, southeast side, leg. R. Newbold, III-18-00 (BISH 725321–725326).

Baker 1C, west side, 9.1–15.2 m deep, leg. R. Newbold, III-18-00 (BISH 725327–725329).

Baker 1D, west side, leg. R. Newbold, III-19-00 (BISH 725330–725335).

Baker 1E, south side, 13.7 m deep, leg. R. Newbold, III-18-00 (BISH 725336–725342).

BAK-02-04 (00° 11.345′ N, 176° 28.764′ W), dense patches of *Acropora* sp. interspersed with more diverse coral patches, gradual reef slope on south side of island, 7.6–15.2 m deep, leg. P. S. Vroom, I-23-04 (PSV 10572–10585).

BAK-05A-01 (00° 11.781′ N, 176° 29.176′ W), upright branched *Acropora* sp. patches alternating with more diverse areas, reef slope on west side of island, 4.6–15.2 m deep, leg. K. J. Geisler, II-9-01 (PSV 10277–10280).

BAK-05P-02, see BAK-05A-01 for depth and location, leg. P. S. Vroom, I-29-02 (PSV 10329–10334).

BAK-05P-04, see BAK-05A-01 for depth and location, leg. P. S. Vroom, I-24-04 (PSV 10537–10544, PSV 10546).

BAK-07-01 (00° 11.455′ N, 176° 29.335′ W), upright branched *Acropora* sp., reef slope on southwest finger, 9.4–13.1 m deep, leg. K. J. Geisler, II-7-01 (PSV 10310) and II-9-01 (PSV 10311–10315).

BAK-07-04, see BAK-07-01 for depth and location, leg. P. S. Vroom, I-24-04 (PSV 10528–10536).

BAK-08-01 (00° 11.915′ N, 176° 29.098′ W), reef wall, west side of island, 15.2 m deep, leg. K. J. Geisler, II-9-01 (PSV 10376–10386).

BAK-09-01 (00° 11.208′ N, 176° 28.204′ W), dense mounds of branched coralline algae in shallower water with occasional patches of an upright branched *Acropora* sp. separated by diverse stretches of reef slope, Lighthouse, southeast corner of island, 4.6–15.2 m deep, leg. K. J. Geisler, II-9-01 (PSV 10316–10322).

BAK-09-04, see BAK-09-01 for depth and location, leg. P. S. Vroom, I-23-04 (PSV 10547–10558).

BAK-10-01 (00° 12.301′ N, 176° 28.704′ W), reef shelf, north end of island, 14.9 m deep, leg. K. J. Geisler, II-10-01 (PSV 10260–10276).

BAK-11A-01 (00° 11.941′ N, 176° 29.078′ W), upright branched *Acropora* sp. patches alternating with more diverse areas, sloping reef wall on west side of island, 4.6–15.6 m deep, leg. K. J. Geisler, II-10-01 (PSV 10359–10368).

BAK-11P-02, see BAK-11A-01 for depth and location, leg. P. S. Vroom, I-30-02 (PSV 10114–10115, PSV 10369–10374).

BAK-11P-04, see BAK-11A-01 for depth and location, leg. P. S. Vroom, I-24-04 (PSV 10517–10527).

Inshore from BAK-11A-01, reef flat, 0–1 m deep, leg. L. S. Godwin, I-30-02 (PSV 10393).

BAK-13-02 (00° 11.910′ N, 176° 27.810′ W), reef slope on east side of island, 11.0 m deep, leg. P. S. Vroom, I-29-02 (PSV 10116, PSV 10259a–h, PSV 10264).

BAK-14-02 (00° 12.319′ N, 176° 28.464′ W), reef slope on north side of island, leg. P. S. Vroom, I-29-02 (PSV 10117, PSV 10118, PSV 10227; BISH 724053–724058).

BAK-15-02 (00° 12.219′ N, 176° 28.125′ W), reef slope on northeast side of island, 11.0 m deep, leg. P. S. Vroom, I-30-02 (PSV 10119, PSV 10120, PSV 10282–10305).

BAK-16P-02 (00° 11.698′ N, 176° 27.753′ W), monotypic thicket of an upright branched *Acropora* sp. with occasional sand patch, shelf on east side of island, 10.7 m deep, leg. P. S. Vroom, I-20-02 (PSV 10253–10255).

BAK-16P-04, see BAK-16P-02 for depth and location, leg. P. S. Vroom, I-23-04 (PSV 10559–10571).

BAK-Reef Flat-02, east side, 0–1 m deep, leg. S. R. Holzwarth, I-29-02 (PSV 10121, PSV 10256, PSV 10257).

Howland Island

U.S. Fish and Wildlife Service

Reef Flat, west shoreline, <0.6 m deep, leg. K. B. Foster, III-5-98 (BISH 725343–725346).

National Marine Fisheries Service

Howland 1A, east side, 9.1 m deep, leg. F. A. Parrish, III-17-00 (BISH 725347).

Howland 1B, east side, tidal flat, leg. F. A. Parrish, III-17-00 (BISH 725348).

Howland 1Ba, west side, 9.1–15.2 m deep, leg. R. Newbold, III-16-00 (BISH 725349, 725350).

Howland 1C, southeast side, tidal flat, leg. R. Newbold, III-17-00 (BISH 725351–725363).

Howland 1D, west side, 9.1–15.2 m deep, leg. R. Newbold, III-18-00 (BISH 725364–725368).

Howland 1E, southwest side, 4.9–6.7 m deep, leg. R. Newbold, III-17-00 (BISH 725369, 725370).

HOW-05P-01 (00° 48.340′ N, 176° 37.272′ W), steep reef slope off reef flat on west side of island, 6.1–13.1 m deep, leg. K. J. Geisler, II-7-01 (PSV 10323–10327).

HOW-05P-02, see HOW-05P-01 for depth and location, leg. P. S. Vroom, I-31-02 (PSV 10344–10350).

HOW-05P-04, see HOW-05P-01 for depth and location, leg. P. S. Vroom, I-21-04 (PSV 10489–10495).

HOW-05P-04-Deep, see HOW-05P-01 for location, 21.0–24.8 m deep, leg. P. S. Vroom, I-22-04 (PSV 10586–10592).
HOW-07-01 (00° 48.818′ N, 176° 37.414′ W), reef wall on west side, north sector of island, 15.5 m deep, leg. K. J. Geisler, II-7-01 (PSV 10306–10310, PSV 10328).
HOW-08-01 (00° 47.986′ N, 176° 37.240′ W), reef wall on west side, south sector of island, 13.7 m deep, leg. K. J. Geisler, II-7-01 (PSV 10335–10343).
HOW-09-01 (00° 48.437′ N, 176° 36.573′ W), reef wall on east side, midsector of island, 18.0 m deep, leg. K. J. Geisler, II-8-01 (PSV 10258, PSV 10259–10261).
HOW-10-01 (00° 47.388′ N, 176° 36.977′ W), reef wall on south end of island, 17.1 m deep, leg. K. J. Geisler, II-8-01 (PSV 10387–10391).
HOW-11P-02 (00° 47.926′ N, 176° 37.223′ W), steep reef slope near island reef on west side, south sector of island, 6.1–12.2 m deep, leg. P. S. Vroom, II-1-02 (PSV 10124, PSV 10125, PSV 10352–10358).
HOW-11P-04, see HOW-11P-02 for depth and location, leg. P. S. Vroom, I-21-04 (PSV 10480–10487, PSV 10593–10601).
HOW-12-02 (00° 48.555′ N, 176° 36.639′ W), reef slope, east side, midsector of island, 13.1 m deep, leg. P. S. Vroom, I-31-02 (PSV 10126, PSV 10248–10252).
HOW-13-02 (00° 49.194′ N, 176° 36.971′ W), reef slope, northeast corner of island, 11.0 m deep, leg. P. S. Vroom, I-31-02 (PSV 10238–10247).
HOW-14P-02 (00° 48.895′ N, 176° 37.433′ W), steep reef slope near island reef on west side, north sector of island, 6.1–12.2 m deep, leg. P. S. Vroom, II-1-02 (PSV 10234–10237).
HOW-14P-04, see HOW-14P-02 for depth and location, leg. P. S. Vroom, I-21-04 (PSV 10497–10504).
HOW-15-02 (00° 48.481′ N, 176° 37.310′ W), reef slope on west side, midsector of island, 11.0 m deep, leg. P. S. Vroom, II-1-02 (PSV 10228–10233).
HOW-16-04 (00° 48.645′ N, 176° 37.358′ W), steep reef slope near island reef on west side, north sector of island, 6.1–12.2 m deep, leg. P. S. Vroom, I-21-04 (PSV 10509–10516).
HOW-17-04 (site HOW-11P-02 in deeper water), reef slope, west side, south sector of island, 13.0–27.7 m deep, leg. P. S. Vroom, I-22-04 (PSV 10586–10592).